Drawings by Stuart Judd, Jr.

Future Voters
DISCUSSION GUIDE

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ATOMIC DEVELOPMENT: WHICH WAY?

Unlike many other great scientific accomplishments, such as generating electricity, the discovery of how to release atomic energy has had an outside-in beginning.

It was first applied to meet the demands of war, not the needs of peace.

That circumstance, and the present divided state of the world, have controlled its development and delayed its constructive use.

During World War II our government, aware that our foes were hunting for the key to the atom for bombs, invested billions of dollars in the Manhattan project, our own bomb development program.

So well did the Manhattan project keep its secrets that most Americans didn't realize the Atomic Age had begun till it mushroomed in a devastating cloud over Nagasaki and Hiroshima.

After the war, the Atomic Energy Act of 1946, though hanging on to security measures and keeping the program in government hands, proposed that "the development and utilization of atomic energy . . . be directed toward improving public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace."

But instead of finding ourselves in one world, we woke up to the fact there were two, with communist Russia and her satellites arrayed against her wartime allies the free nations of the West.

As the situation worsened, our hope of atoms for peace gave way to atoms for defense. Once more the major effort of our atomic program was to make bombs fast. When the U.S.S.R., too, got the A and then H bomb, our stockpile helped keep us ahead in the race—but for how long, nobody knows.

The hope remains that the time will never come when this destroying force will be let loose.

No matter how much the divided world and the demands of security may cause delay, our atoms for peace objective still holds good.

Recent indications show that a shift in emphasis may be taking place.

One is President Eisenhower's proposal for an international pool to develop atoms for peace. Another is the 1954 revision of the Atomic Energy Act, loosening somewhat the government's monopoly in order to permit, within security safeguards, private development. Still another is the fact that, near Shippingport, Pa., construction is well under way on the nation's first full-scale atomic power plant, capable of generating enough electricity to supply a city of 75,000.

And almost every day there's further news of how our control over the atom is proving useful in medicine and other fields.

Two years ago Dr. Charles Allen Thomas, President of the Monsanto Chemical Company, remarked: "With all the talking we have done on how atomic energy can be beneficial as well as destructive, it is a pity we have not shown the world the truth of our words."

Let's consider how we're doing so now.

THE ATOMIC CHAIN

What started it all was Dr. Einstein's proposal, set forth in 1905 in a now famous equation, that matter (made up of innumerable atoms) could be changed into energy.

In their laboratories, physicists began trying to make it come true.

It wasn't till 1938, shortly before World War II, that they met with success. In Nazi Germany, Physicists Otto Hahn and Fritz Strassman found how to split the uranium atom by bombarding it with neutrons. During this splitting or "fissioning" into lighter elements, a small flash showed that some of the material had been converted into energy instead of other particles. Six years later this tiny explosion led to the big one at Alamogordo, New Mexico. For a big

release of energy—or a big explosion—the fission of the first atom has to cause the splitting of many more in what is known as a chain reaction. How to cause and control a chain reaction still waited to be done.

Lise Meitner, one of the physicists who had worked with Hahn, fled from Germany because Hitler was oppressing the Jews.

Thus Hitler's political policies started a chain reaction of their own.

Lise Meitner told Niels Bohr, the great Danish Physicist, about Hahn's success.

When Bohr, in 1939, came to the U.S.A. for a scientific conference, he passed Dr. Meitner's news along to Enrico Fermi, a refugee from Fascist Italy working at Columbia University. The information from Bohr helped Fermi in his own atom splitting experiments. With a co-worker, Leo Szilard, he wrote a paper about these researches. The next link in the chain was that Dr. Einstein read Fermi's account. Because the war was on, Dr. Einstein discussed with other scientists the possibility of making an atomic bomb. The idea was laid before President Franklin Roosevelt.

The six thousand dollars first allotted to study the question mushroomed, after Pearl Harbor, into the more than twelve billion we've spent, to date, on the government's atomic energy program.

The first chain reaction in atomic fission—the step still needed for its practical use—took place on December 2, 1942, under the direction of Enrico Fermi at the University of Chicago's Metallurgical Laboratory. To carry it out, Fermi and his associates built an atomic pile—what is now known as a "reactor." It was a massive affair housed in a squash court out at Stagg Field. Chief reason for its size was the fact that what would be going on within the core could be highly dangerous to people outside. Besides energy in the form of heat, the expected continuing fission process would release rays which, unless stopped by a barrier, would cause death. This first reactor was therefore surrounded by a bulky "shield." Shielding remains one of the many problems in building reactors.

In the heart of this first reactor, special equipment and a carefully planned arrangement of uranium and other substances had been placed, including a moderating material—graphite—which would serve to keep the fission process in check.

The reactor was started from a remote control panel. As dials moved and instruments clicked, atoms of fissionable uranium began to split and fly apart with tremendous force and a release of heat. Due to the particular adjustments of the graphite grid and materials, some of the particles (neutrons) from splitting atoms caused other fissionable uranium nuclei to split, setting up the chain reaction.

The power of the atom had been successfully harnessed. The controlled, self-sustaining chain reaction would continue as long as it had fuel.

Without a moderator to slow the process up, it would go off as a bomb.

ATOMS FOR PEACE

The story of the making of the A and then the H bomb is so familiar that it needs no retelling. What we're not as well acquainted with is the development of the atom's possibilities for peace.

These possibilities have been with us right along. The government installation known as the Hanford Works, in the State of Washington, serves to illustrate this. At Hanford, great reactors are busy producing from uranium a man-made fissionable material, called plutonium, which is used for bombs. In doing this, a great deal of energy in the form of heat is generated—so much so that, as with all controlled nuclear fission processes, the reactors have to be cooled off. At Hanford, water from the Columbia River does the job. The heat now wasted because it is lost in the river could be used, instead, to run a plant for generating electricity. But before this could be done, there'd have to be all sorts of modification in the Hanford reactors. Plutonium, not electricity, is Hanford's all-important job. So it sticks to its task of making this fuel to build up Uncle Sam's stockpile of bombs.

But just as we can't afford not to be strong, we can't afford to neglect constructive uses of the atom to show that our main purpose is peace. The possibilities for peaceful use are so great that it would hurt our position of world leadership if we failed to do all we can to develop them.

The 1954 Atomic Energy Act prepares the way.

These are some of the important provisions of the bill.

We might think about and discuss each as we go along.

With regard to military use:

(1) The bill enables the President to share with our NATO allies limited information on the use of nuclear weapons in order to help plan the defense of Europe. Such sharing had been prohibited under the 1946 Act, putting an end to the wartime cooperation with Britain and Canada which helped build the first bombs.

With regard to atoms for peace:

(2) The 1946 law was passed when we alone had the atomic bomb, and hoped to hold our monopoly for as long as we could. Therefore the law continued the government's wartime control and ownership of everything connected with our atomic program. Hush hush was considered essential. So intent were we on keeping our secrets from unfriendly nations that we kept atomic knowledge from the vast majority of our citizens as well. Only the demands of security can justify such a policy in a government of, by, and for the people. Under the 1954 Act, with conditions changed and Russia, too, possessing the secret of the atom, a freer policy of releasing non-military information helpful for industrial and other uses becomes possible. Subject to government regulation, industry gets the right to own and operate nuclear reactors. It can use fissionable material in its own installations and for its own purposes—though for the sake of security the government will continue to hang on to the ownership of all such material.

(3) All patentable discoveries, under the old law, remained the property of the government's Atomic Energy Commission. Under the new law patents on inventions having to do with non-military use in the atomic energy field will, with one difference, be granted as in

■*What happens when an H bomb explodes is the reverse of the A bomb process. Instead of atoms breaking apart, they rush together or fuse. The burning of the sun is due to fusion. Nothing's hotter than that.*

other fields. The exception, recommended by President Eisenhower to prevent a small number of firms from controlling all patents and thus setting up a monopoly, requires holders of those patents to lease them for a term of five years to others who wish to make use of them. After that, as with normal patent laws, these patents will become the exclusive property of their owners for the next seventeen years.

During debate on the bill, this provision stirred up plenty of argument. It has been challenged by Representative W. Sterling Cole, Chairman of the Joint Congressional Committee on Atomic Energy in the 83d Congress, as tending to "discourage and stifle initiative." Congressman Cole says that he will move for its amendment in the next session of Congress.

(4) The bill makes possible an exchange of atomic information with friendly nations on peaceful application of atomic energy, and clears the way for President Eisenhower's proposal for an international pool.

(5) The bill gives preference to rural electric cooperatives, municipal power plants, and similar projects which wish to use the government's atomic program and power.

Along with the arguments over patent sharing, the preference question stirred up one of the bitterest controversies in the 83d Congress, with those favoring the preference provision winning out. Specifically, the arguments, pro and con, have we read or heard on the patent, licensing and preference questions? What are our own views? Consideration of the 1954 Bill stirred up the general question of public vs. private development of atomic energy. According to Chairman Cole, opinions ran "the gamut from encouragement of all out private power development . . . to allowing only government development." After we've read the [illegible] of the Guide, we might [illegible] of this question of public vs. private development.

There is general agreement that generating electricity from atomic energy seems the most promising industrial use.

Atomic power plants would have many good points. One is fuel. The world's reserves of uranium ore are estimated to be at least twenty-five times greater than those of coal, and a hundred times more abundant than oil or gas. The catch is to convert this uranium ore into efficient nuclear fuel at lower costs than possible at present.

Another advantage is that, unlike hydroelectric plants which have to be where there's plenty of water, or plants fueled by coal which is hard to transport, a nuclear power plant can be put up anywhere. Nuclear fuel, once processed, lasts a very long while and can be readily carried. It is almost unbelievably compact—one cubic inch of it (ice cube size) gives as much heat energy as two million six hundred thousand pounds of coal.

Advantages like these make atomic energy immensely significant. It is especially important for countries where there's little water power, as in Britain, or conventional fuels are scarce or running low. It could mean a great deal, too, for undeveloped countries.

As for our own program, Chairman Cole's summary of the Hearings before passage of the bill helps to show where we stand.

No one—he reported—has suggested that private industry is ready to finance all research and development still needed to make commercial atomic power a reality. Everyone—he went on—urged the Atomic Energy Commission to continue a vigorous reactor research and development program. Everyone noted the necessity for indefinite continuance of federal regulations for the sake of security and other reasons. All seemed agreed that atomic power is important to the future economic well-being of the United States and of the entire world.

Let's see now what some of the problems of atomic power are, and how they may be met.

The most practical and simplest method—it is generally agreed—of converting atomic energy into electricity is to do it by means of the heat that's produced when nuclear fission takes place in a reactor. The heat can be made to change water into steam. Like any conventional power plant, the steam then turns the turbines that drive the dynamos that generate the electricity.

As early as December, 1951, at the A.E.C.'s Reactor Testing Station at Arco, Idaho, electricity was for the first time successfully made in this way. It's been done, too, at Oak Ridge.

Also at Arco, a test reactor like the one that will power the U.S.S. Nautilus, the world's first atomic submarine, by heating steam to drive her turbines, has been used to generate electricity.* Like the atomic planes on which we're working, we built the Nautilus because she's a military necessity, able to do things no other submarine could do—such as cruising 25,000 miles without refueling, or crossing the Atlantic completely submerged at full speed. But building the Nautilus, because of her engines, has cost twice as much as building an ordinary submarine—a pretty good indication of the present greater expense of atomic power plants as compared with the common or garden variety. This extra expense wouldn't be economically justified if what we're building is just a power plant for making electricity. To make good business sense, and compete commercially, we'll have to learn how to make and operate atomic energy power plants at about the same costs as the plants we're now using.

What's needed is a great deal of experimentation. Experimentation doesn't mean just theoretical figuring and laboratory tests. It means doing and studying the real thing. That's where plants like the one being built at Shippingport, with half the cost borne by industry, half by the government, and to be ready for use by 1957, will be a great help.

Aside from costs, there are plenty of technical problems. A big one is radiation. Besides making shielding necessary to protect the plant personnel, radioactivity plus heat can be very damaging to materials from which a reactor is made. Radiation also greatly increases the difficulty of repairs. With a coal furnace, "shaking the grate" is all that's required to get rid of ashes. Because of radioactivity, the process of getting rid of burned out but radioactive material becomes complicated. Radioactivity can also render dangerous and destructive the heat-transferring fluids or gas used to make steam.

But technical problems just as tough have been solved before. If we're slow in getting going, we may find other countries ahead of us. Reports from Britain indicate that her power program is moving a good bit faster than ours. Russia, too, says she's generating electricity.

Improving reactors for power plants is the big part of the job. There's no such thing as a "typical" reactor. They can be built out of a variety of materials and use fuel in a variety of forms, such as plates, powders, threads, rods, or as liquid. The core can be as small as a football or as big as a six room house.

The entering wedge to make atomic power plants economically attractive may be to encourage industry to build "double purpose" reactors. These would be like the reactors at Hanford for making plutonium, but the heat generated could also be used for steam to run a power plant. In a "double purpose" reactor, extra costs could be taken care of by the price which the government would pay for the plutonium it needs.

What are the points in favor, what those against such a plan?

For obvious security reasons, the number of kilowatts generated by the Nautilus-type reactor has not been disclosed.

One of the most amazing nuclear fission furnaces of the plutonium making type is known as a "breeder" reactor. It is still being developed. Only about 1% of the silvery white metal known as uranium is actually fissionable. This 1% is uranium-235. A breeder reactor, by fissioning or "burning" uranium-235, turns non-fissioning uranium into usable fissioning material at a rate equal to or exceeding the amount of fissionable material used in carrying on the process—thus "breeding" more fuel than it consumes. The importance of this is that the process will let us use all the uranium we mine—whether it's fissionable or not. Since we know that the earth contains uranium in great plenty, atomic energy, because of this breeding process, will be with us for a long, long time.

WHAT ELSE?

Besides using the *heat* of nuclear fission to generate power with all its uses, or to test metals, the deadly *radioactivity* of nuclear fission has also been harnessed and controlled for the benefit of mankind. Ordinary cobalt, in tiny particles or in wafers the size of a dime, after exposure or "baking" in an atomic reactor, becomes radioactive itself. After "cooling off," such radioactive particles ("isotopes"), capable of abundant and inexpensive production, are useful for a great and growing variety of purposes: treatment of cancer and other disease, checking bacterial action as a way to preserve food, sterilizing medical supplies, conditioning fertilizers to stimulate plant growth. Industrially, new, inexpensive gauges now employ these isotopes to measure with greatest accuracy the thickness of plastics, paper, rubber, and metals. Isotopes can detect flaws in boiler plates, weldings, and castings. They can determine wear and tear in machinery.

THE CHOICE

President Eisenhower's plan to establish "under the aegis of the United Nations an international atomic energy agency to receive supplies of nuclear materials from those member nations having stocks of such materials" is designed to further all these constructive purposes. This proposed international atomic bank is to "encourage world-wide research and development of peaceful uses of atomic energy by assuring that engineers and scientists of the world have sufficient materials to conduct such activities and by fostering the interchange of information."

It offers a way to begin moving fissionable materials out of the world's arsenals. It can be done, as the President suggests, "without the irritations and mutual suspicion incident to any attempt to set up a completely acceptable system of world-wide inspection and control."

Obviously one great aim is to focus the world's attention on the constructive rather than the destructive possibilities of the atom and set the world to work developing uses which can help us all.

Unless something of the sort is done to stimulate world cooperation in developing atoms for peace—unless we begin thus beating our swords into plowshares—the alternative, in the President's words, remains that of "two atomic colossi doomed malevolently to eye each other indefinitely across a trembling world."

There's plenty of reason for trembling. "Atomic bombs"—the President pointed out—"today are more than twenty-five times as powerful as the weapons with which the atomic age dawned—while hydrogen weapons are in the range of millions of tons of TNT equivalent."

If the H bombs tested with awesome results by both the U.S.A. and Russia had been encased in cobalt sheaths, each, besides creating a stupendous explosion, would have spread over thousands of square miles a cloud of deadly radioactive dust.

It's plain that the world now has the knowledge to destroy itself.

Can it also command the wisdom to save itself and to benefit from the secrets of the atom which man's genius has unlocked?

In which way or ways do the latest world debates, trends, acts, and plans seem to indicate we're moving? Let's lift and discuss them!

Coming: Guides on Questions Facing the 84th Congress.